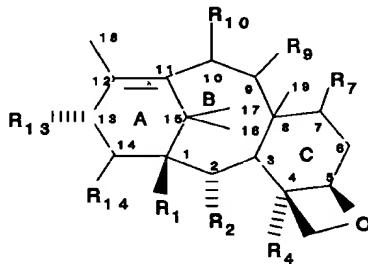


What is claimed is:

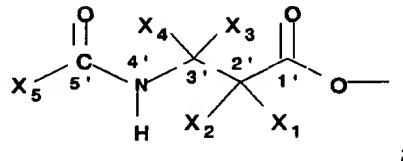
1. A process for the acylation of a C(10) hydroxy group of a taxane, the process comprising treating the taxane with an acylating agent in a reaction mixture containing less than one equivalent of 5 an amine base for each equivalent of taxane to form a C(10) acylated taxane.
2. The process of claim 1 wherein the taxane has C(7) and C(10) hydroxy groups and the acylating agent selectively reacts with the C(10) hydroxy group.
3. The process of claim 1 wherein the taxane reacted with the acylating agent is 10-deacetyl baccatin III.
4. The process of claim 1 wherein the taxane has the structure:



wherein

- 5 R_1 is hydrogen, hydroxy, protected hydroxy, or together with R_{14} or R_2 forms a carbonate;
- R_2 is keto, $-OT_2$, acyloxy, or together with R_1 forms a carbonate;
- R_4 is $-OT_4$ or acyloxy;
- 10 R_7 is hydrogen, halogen, $-OT_2$, $-OCOZ_7$, or $-OCOOZ_7$;
- R_9 is hydrogen, keto, $-OT_9$, $-OCOZ_9$, or $-OCOOZ_9$;
- R_{10} is hydroxy;

R₁₃ is hydroxy, protected hydroxy, keto, or



15 R₁₄ is hydrogen, -OT₁₄, acyloxy, or together with R₁ forms a carbonate;

T₂, T₄, T₇, T₉ and T₁₄ are independently hydrogen or hydroxy protecting group;

X₁ is -OX₆, -SX₇, or -NX₈X₉;

20 X₂ is hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

X₃ and X₄ are independently hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

X₅ is -X₁₀, -OX₁₀, -SX₁₀, -NX₈X₁₀, or -SO₂X₁₁;

25 X₆ is hydrocarbyl, substituted hydrocarbyl, heteroaryl, hydroxy protecting group or a functional group which increases the water solubility of the taxane derivative;

X₇ is hydrocarbyl, substituted hydrocarbyl, heteroaryl, or sulfhydryl protecting group;

X₈ is hydrogen, hydrocarbyl, or substituted hydrocarbyl;

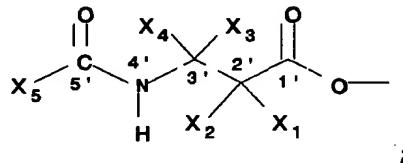
X₉ is an amino protecting group;

X₁₀ is hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

X₁₁ is hydrocarbyl, substituted hydrocarbyl, heteroaryl, -OX₁₀, or -NX₈X₁₄; and

X₁₄ is hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl.

5. The process of claim 4 wherein
R₁ is hydroxy or together with R₁₄ or R₂ forms a carbonate;
R₂ is -OCOZ₂, -OCOOZ₂, or together with R₁ forms a carbonate;
R₄ is -OCOZ₄;
R₉ is hydrogen or keto;
R₁₃ is hydroxy, protected hydroxy, or



10 R_{14} is hydrogen, hydroxy, protected hydroxy, or
 together with R_1 forms a carbonate;
 X_1 is $-OX_6$ or $-NX_8X_9$;
 X_2 is hydrogen, hydrocarbyl, or substituted
 hydrocarbyl;
15 X_3 and X_4 are independently hydrogen, hydrocarbyl,
 substituted hydrocarbyl, or heteroaryl;
 X_5 is $-X_{10}$, $-OX_{10}$, or $-NX_8X_{10}$;
 X_6 is a hydroxy protecting group;
 X_8 is hydrogen, hydrocarbyl, or substituted
20 hydrocarbyl;
 X_9 is an amino protecting group;
 X_{10} is hydrocarbyl, substituted hydrocarbyl, or
 heteroaryl; and
 Z_2 and Z_4 are independently hydrocarbyl, substituted
25 hydrocarbyl, or heteroaryl.

6. The process of claim 1 wherein the acylating agent is selected from the group consisting of

anhydrides, dicarbonates, thiodicarbonates, and isocyanates.

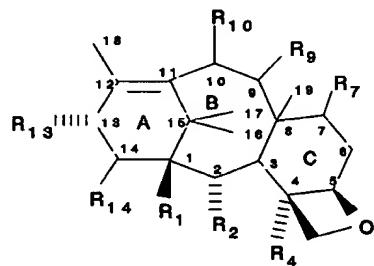
7. The process of claim 6 wherein the reaction mixture contains a Lewis acid.

8. The process of claim 7 wherein the taxane reacted with the acylating agent is 10-deacetyl baccatin III.

9. The process of claim 1 wherein the reaction mixture contains a Lewis acid.

10. The process of claim 9 wherein the taxane reacted with the acylating agent is 10-deacetyl baccatin III.

11. The process of claim 9 wherein the taxane has the structure:



wherein

5 R_1 is hydrogen, hydroxy, protected hydroxy, or together with R_{14} or R_2 forms a carbonate;

R_2 is keto, $-OT_2$, acyloxy, or together with R_1 forms a carbonate;

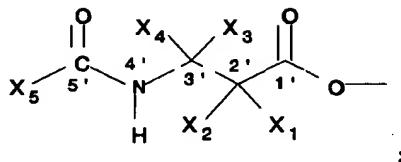
R_4 is $-OT_4$ or acyloxy;

10 R_7 is hydrogen, halogen, $-OT_2$, $-OCOZ_7$, or $-OCOOZ_7$;

R_9 is hydrogen, keto, $-OT_9$, $-OCOZ_9$, or $-OCOOZ_9$;

R_{10} is hydroxy;

R_{13} is hydroxy, protected hydroxy, keto, or



15 R_{14} is hydrogen, $-OT_{14}$, acyloxy, or together with R_1 forms a carbonate;

T_2 , T_4 , T_7 , T_9 , and T_{14} are independently hydrogen or hydroxy protecting group;

X_1 is $-OX_6$, $-SX_7$, or $-NX_8X_9$;

20 X_2 is hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

X_3 and X_4 are independently hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

X_5 is $-X_{10}$, $-OX_{10}$, $-SX_{10}$, $-NX_8X_{10}$, or $-SO_2X_{11}$;

25 X_6 is hydrocarbyl, substituted hydrocarbyl, heteroaryl, hydroxy protecting group or a functional group which increases the water solubility of the taxane derivative;

30 X_7 is hydrocarbyl, substituted hydrocarbyl, heteroaryl, or sulfhydryl protecting group;

X_8 is hydrogen, hydrocarbyl, or substituted hydrocarbyl;

X_9 is an amino protecting group;

35 X_{10} is hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

X_{11} is hydrocarbyl, substituted hydrocarbyl, heteroaryl, $-OX_{10}$, or $-NX_8X_{14}$; and

X_{14} is hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl.

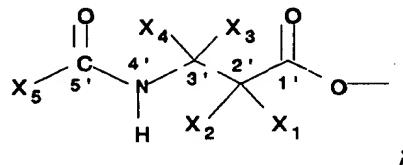
12. The process of claim 11 wherein
R₁ is hydroxy or together with R₁₄ or R₂ forms a
carbonate.

R₂ is -OCOZ₂, -OCOOZ₂, or together with R₁ forms a carbonate;

R_4 is $-OCOZ_4$;

R₉ is hydrogen or keto;

R_{13} is hydroxy, protected hydroxy, or



10 R_{14} is hydrogen, hydroxy, protected hydroxy, or together with R_1 forms a carbonate;

X_1 is $-OX_6$ or $-NX_8X_9$;

X_2 is hydrogen, hydrocarbyl, or substituted hydrocarbyl;

15 X_3 and X_4 are independently hydrogen, hydrocarbyl,
 substituted hydrocarbyl, or heteroaryl;

X_5 is $-X_{10}$, $-OX_{10}$, or $-NX_8X_{10}$;

X_6 is a hydroxy protecting group;

X_8 is hydrogen, hydrocarbyl, or substituted

20 hydrocarbyl;

X, is an amino protecting group;

X_{10} is hydrocarbyl, substituted hydrocarbyl, or heteroaryl; and

Z_2 and Z_4 are independently hydrocarbyl, substituted hydrocarbyl, or heteroaryl.

13. The process of claim 9 wherein the Lewis acid is selected from the group consisting of the halides or

triflates of the Group IB, IIB, IIIB, IVB, VB, VIIIB, VIII, IIIA, IVA, lanthanide and actinide elements.

14. The process of claim 13 wherein the Lewis acid is selected from the group consisting of zinc chloride, stannic chloride, cerium trichloride, cuprous chloride, lanthanum trichloride, dysprosium trichloride and 5 ytterbium trichloride.

15. The process of claim 1 wherein the C(10) acylated taxane comprises a C(7) hydroxy group and the process additionally comprises treating the C(10) acylated taxane with a silylating agent to silylate the C(7) hydroxy group.

16. The process of claim 15 wherein the C(10) acylated taxane is baccatin III.

17. The process of claim 1 wherein the C(10) acylated taxane comprises a C(7) hydroxy group and the process additionally comprises treating the C(10) acylated taxane with an acylating agent to acylate the C(7) hydroxy group.

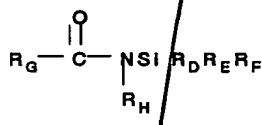
18. The process of claim 17 wherein the C(10) acylated taxane is baccatin III.

19. The process of claim 1 wherein the C(10) acylated taxane comprises a C(13) hydroxy, metallic oxide, or ammonium oxide substituent and the process additionally comprises the step of esterifying the C(10) acylated taxane by treating the C(10) acylated taxane with a side chain precursor selected from the group consisting of β -lactams, oxazolines, oxazolidine

carboxylic acids, oxazolidine carboxylic acid anhydrides, and isoserine derivatives.

20. A process for the silylation of a C(10) hydroxy group of a taxane, the process comprising treating the taxane with a silyl amide or a bis(silyl amide) to form a C(10) silylated taxane.

21. The process of claim 20 wherein the silylamine or bis(silylamine) corresponds to structures 6 or 7, respectively:



5

6

7

wherein R_D , R_E , R_F , R_G , and R_H are independently hydrocarbyl, substituted hydrocarbyl, or heteroaryl.

22. The process of claim 21 wherein the taxane is treated with the silyl amide or bis(silyl) amide in the presence of an alkali metal base catalyst.

23. The process of claim 21 wherein the taxane is treated with the silylamide or bis(silylamide) in the presence of a catalyst selected from the group consisting of lithium amide catalysts.

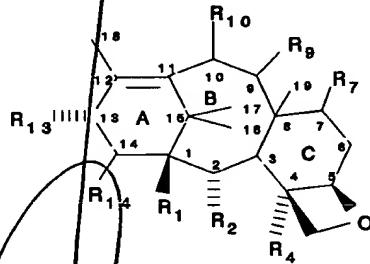
24. The process of claim 20 wherein the silylamine or bis(silylamine) is selected from the group consisting of tri(hydrocarbyl)-silyl-trifluoromethylacetamides and bis tri(hydrocarbyl)-silyltrifluoromethylacetamides, with the

5 hydrocarbyl moiety being substituted or unsubstituted alkyl or aryl.

25. The process of claim 20 wherein the C(10) silylated taxane comprises a C(7) hydroxy group and the process additionally comprises treating the C(10) silylated taxane with an acylating agent to acylate the 5 C(7) hydroxy group.

26. The process of claim 20 wherein the taxane treated with the silylamide or bissilylamide is 10-deacetyl baccatin III and the process additionally comprises treating the C(10) silylated taxane with an 5 acylating agent to acylate the C(7) hydroxy group.

27. The process of claim 20 wherein the taxane has the structure:



wherein

5 R_1 is hydrogen, hydroxy, protected hydroxy, or together with R_{14} or R_2 forms a carbonate;

10 R_2 is keto, $-OT_2$, acyloxy or together with R_1 forms a carbonate;

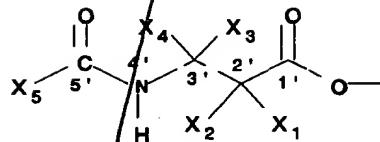
15 R_4 is $-OT_4$ or acyloxy;

20 R_7 is hydrogen, halogen, $-OT_2$, or acyloxy;

25 R_9 is hydrogen, keto, $-OT_2$, or acyloxy;

30 R_{10} is hydroxy;

35 R_{13} is hydroxy, protected hydroxy, keto, or



15 R_{14} is hydrogen, $-OT_{14}$, acyloxy, or together with R_1 forms a carbonate;

16 T_2 , T_4 , T_7 , T_9 , and T_{14} are independently hydrogen or hydroxy protecting group;

17 X_1 is $-OX_6$, $-SX_7$, or $-NX_8X_9$;

20 X_2 is hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

21 X_3 and X_4 are independently hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

22 X_5 is $-X_{10}$, $-OX_{10}$, $-SX_{10}$, $-NX_8X_{10}$,

25 or $-SO_2X_{11}$;

26 X_6 is hydrocarbyl, substituted hydrocarbyl, heteroaryl, hydroxy protecting group or a functional group which increases the water solubility of the taxane derivative;

30 X_7 is hydrocarbyl, substituted hydrocarbyl, heteroaryl, or sulfhydryl protecting group;

31 X_8 is hydrogen, hydrocarbyl, or substituted hydrocarbyl;

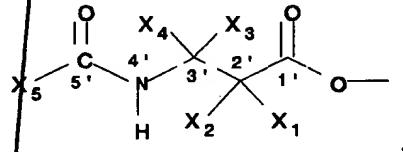
32 X_9 is an amino protecting group;

35 X_{10} is hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

36 X_{11} is hydrocarbyl, substituted hydrocarbyl, heteroaryl, $-OX_{10}$, or $-NX_8X_{14}$; and

40 X_{14} is hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl.

28. The process of claim 27 wherein
R₁ is hydroxy or together with R₁₄ or R₂ forms a
carbonate;
R₂ is -OCOZ₂, -OCOOZ₂, or together with R₁ forms a
5 carbonate;
R₄ is -OCOZ₄;
R₉ is hydrogen or keto;
R₁₃ is hydroxy, protected hydroxy, or



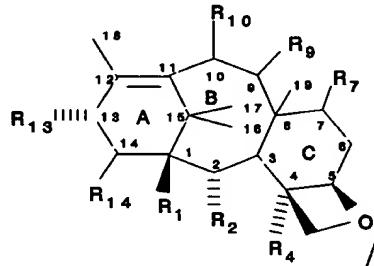
10 R₁₄ is hydrogen, hydroxy, protected hydroxy, or
together with R₁ forms a carbonate;
X₁ is -OX₆ or -NX₈X₉;
X₂ is hydrogen, hydrocarbyl, or substituted
hydrocarbyl;
15 X₃ and X₄ are independently hydrogen, hydrocarbyl,
substituted hydrocarbyl, or heteroaryl;
X₅ is -X₁₀, -OX₁₀, or -NX₈X₁₀;
X₆ is a hydroxy protecting group;
X₈ is hydrogen, hydrocarbyl, or substituted
20 hydrocarbyl;
X₉ is an amino protecting group;
X₁₀ is hydrocarbyl, substituted hydrocarbyl, or
heteroaryl; and
25 Z₂ and Z₄ are independently hydrocarbyl, substituted
hydrocarbyl, or heteroaryl.

29. A process for converting the C(7) hydroxy group
of a 10-acyloxy-7-hydroxytaxane to an acetal or ketal,
the process comprising treating the 10-acyloxy-7-

5 hydroxytaxane with a ketalizing agent in the presence of an acid catalyst to form a C(10) ketalized taxane.

30. The process of claim 29 wherein the C(10) substituent of the 10-acyloxy-7-hydroxytaxane is acetoxy.

31. The process of claim 29 wherein the taxane has the structure:



wherein

5 R_1 is hydrogen, hydroxy, protected hydroxy, or together with R_{14} or R_2 forms a carbonate;

R_2 is keto, $-OT_2$, acyloxy, or together with R_1 forms a carbonate;

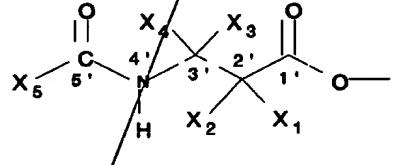
R_4 is $-OT_4$, or acyloxy;

10 R_7 is hydroxy;

R_9 is hydrogen, keto, $-OT_9$, or acyloxy;

R_{10} is acyloxy;

R_{13} is hydroxy, protected hydroxy, keto, or



15 R_{14} is hydrogen, $-OT_4$, acyloxy, or together with R_1 forms a carbonate;

T₂, T₄, T₉, and T₁₄ are independently hydrogen or hydroxy protecting group;

X₁ is -OX₆, -SX₇, or -NX₈X₉;

20 X₂ is hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

X₃ and X₄ are independently hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

25 X₅ is -X₁₀, -OX₁₀, -SX₁₀, -NX₈X₁₀, or -SO₂X₁₁;

X₆ is hydrocarbyl, substituted hydrocarbyl, heteroaryl, hydroxy protecting group or a functional group which increases the water solubility of the taxane derivative;

30 X₇ is hydrocarbyl, substituted hydrocarbyl, heteroaryl, or sulfhydryl protecting group;

X₈ is hydrogen, hydrocarbyl, or substituted hydrocarbyl;

X₉ is an amino protecting group;

35 X₁₀ is hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

X₁₁ is hydrocarbyl, substituted hydrocarbyl, heteroaryl, -OX₁₀, or -NX₈X₁₄; and

40 X₁₄ is hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl.

32. The process of claim 31 wherein

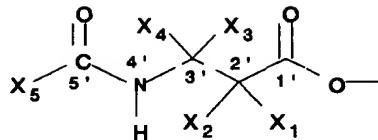
R₁ is hydroxy or together with R₁₄ or R₂ forms a carbonate;

5 R₂ is -OCOZ₂, -OCOOZ₂, or together with R₁ forms a carbonate;

R₄ is -OCOZ₄;

R₉ is hydrogen or keto;

R₁₃ is hydroxy, protected hydroxy, or



10 R_{14} is hydrogen, hydroxy, protected hydroxy, or together with R_1 forms a carbonate;

X_1 is $-OX_6$ or $-NX_8X_9$;

X_2 is hydrogen, hydrocarbyl, or substituted hydrocarbyl;

15 X_3 and X_4 are independently hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

X_5 is $-X_{10}$, $-OX_{10}$, or $-NX_8X_{10}$;

X_6 is a hydroxy protecting group;

X_8 is hydrogen, hydrocarbyl, or substituted

20 hydrocarbyl;

X_9 is an amino protecting group;

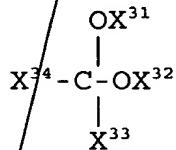
X_{10} is hydrocarbyl, substituted hydrocarbyl, or heteroaryl; and

Z_2 and Z_4 are independently hydrocarbyl, substituted hydrocarbyl, or heteroaryl.

25

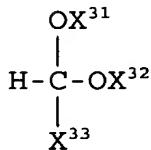
33. The process of claim 29 wherein the acid catalyst is an inorganic acid.

34. The process of claim 29 wherein the ketalizing agent has the formula



wherein X^{31} , X^{32} , X^{33} and X^{34} are independently hydrocarbyl, substituted hydrocarbyl or heteroaryl.

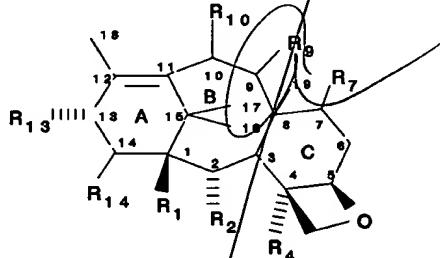
35. The process of claim 29 wherein the ketalizing agent has the formula



wherein X^{31} , X^{32} and X^{33} are independently hydrocarbyl, substituted hydrocarbyl or heteroaryl.

36. The process of claim 29 wherein the ketalizing agent is a vinyl ether.

37. A taxane having the structure:



5

wherein

M is a metal or comprises ammonium:

R_1 is hydrogen, hydroxy, protected hydroxy, or together with R_{14} or R_2 forms a carbonate;

10 R₂ is keto, -OT₂, acyloxy, or together with R₁ forms a carbonate;

R_4 is $-OT_4$ or acyloxy;

R_7 is $-OSiR_JR_KR_L$;

R₉ is hydrogen, keto, -OT₉, or acyloxy;

15 R_{10} is hydrogen, keto, $-OT_{10}$, or acyloxy;

R_{13} is hydroxy, protected hydroxy, keto, or MO-;

R_{14} is hydrogen, $-OT_{14}$, acyloxy, or together with R_1 forms a carbonate;

20 R_J , R_K , R_L are independently hydrocarbyl, substituted hydrocarbyl, or heteroaryl, provided, however, if each of R_J , R_K and R_L are alkyl, at least one of R_J , R_K and R_L comprises a carbon skeleton having at least four carbon atoms; and

25 T_2 , T_4 , T_9 , T_{10} , and T_{14} are independently hydrogen or hydroxy protecting group.

38. The taxane of claim 37 wherein R_{10} is $-OT_{10}$, T_{10} is $SiR_D R_E R_F$, and R_D , R_E , R_F are independently hydrocarbyl, substituted hydrocarbyl, or heteroaryl.

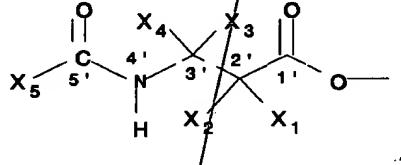
39. The taxane of claim 37 wherein R_1 is hydroxy or together with R_{14} or R_2 forms a carbonate;

5 R_2 is $-OCOZ_2$, $-OCOOZ_2$, or together with R_1 forms a carbonate;

R_4 is $-OCOZ_4$;

R_9 is hydrogen or keto;

R_{13} is hydroxy, protected hydroxy, or



10 R_{14} is hydrogen, hydroxy, protected hydroxy, or together with R_1 forms a carbonate;

X_1 is $-OX_6$ or $-NX_8X_9$;

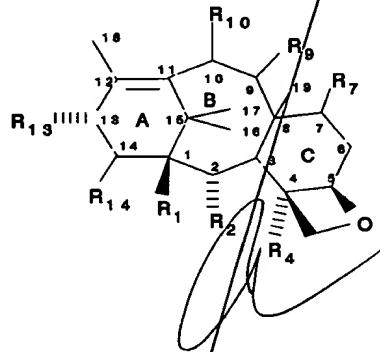
X_2 is hydrogen, hydrocarbyl, or substituted hydrocarbyl;

15 X_3 and X_4 are independently hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;

X_5 is $-X_{10}$, $-OX_{10}$, or $-NX_8X_{10}$;

X₆ is a hydroxy protecting group;
X₈ is hydrogen, hydrocarbyl, or substituted
20 hydrocarbyl;
X₉ is an amino protecting group;
X₁₀ is hydrocarbyl, substituted hydrocarbyl, or
heteroaryl; and
Z₂ and Z₄ are independently hydrocarbyl, substituted
25 hydrocarbyl, or heteroaryl.

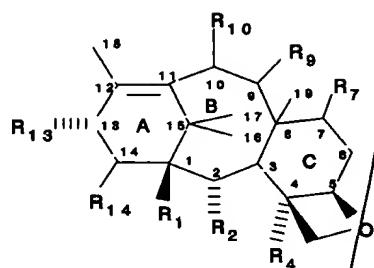
40. A taxane having the structure:



wherein

M is a metal or comprises ammonium;
5 R₁ is hydrogen, hydroxy, protected hydroxy, or
together with R₁₄ or R₂ forms a carbonate;
R₂ is keto, -OT₂, acyloxy, or together with R₁ forms
a carbonate;
R₄ is -OT₄ or acyloxy;
10 R₇ is -OT₁ or acyloxy;
R₉ is hydrogen, keto, -OT₉, or acyloxy;
R₁₀ is acyloxy, provided that the acyl moiety is
other than acetoxy;
R₁₃ is hydroxy, protected hydroxy, keto, or MO-;
15 R₁₄ is hydrogen, -OT₁₄, acyloxy, or together with R₁
forms a carbonate; and
T₂, T₄, T₇, T₉, and T₁₄ are independently hydrogen or
hydroxy protecting group.

41. A taxane having the structure:



wherein

M is a metal or comprises ammonium;

5 R₁ is hydrogen, hydroxy, protected hydroxy, or together with R₁₄ or R₂ forms a carbonate;

R₂ is keto, -OT₂, acyloxy, or together with R₁ forms a carbonate;

10 R₄ is -OT₄ or acyloxy;

R₇ is hydrogen, halogen, -OT₇, or acyloxy;

R₉ is hydrogen, keto, -OT₉, or acyloxy;

R₁₀ is -OSiR_DR_ER_F;

R₁₃ is hydroxy, protected hydroxy, keto, or MO-;

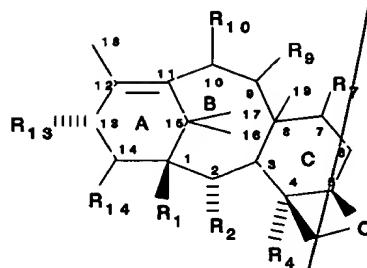
15 R₁₄ is hydrogen, -OT₁₄ or together with R₁ forms a carbonate;

R_D, R_E, R_F are independently hydrocarbyl, substituted hydrocarbyl, or heteroaryl; and

T₂, T₄, T₇, T₉, and T₁₄ are independently hydrogen or hydroxy protecting group.

42. The taxane of claim 40 wherein R₁ is acyloxy.

43. A taxane having the structure:



wherein

M is a metal or comprises ammonium:

5 R₁ is hydrogen, hydroxy, protected hydroxy, or together with R₁₄ or R₂ forms a carbonate;

R₂ is keto, -OT₂, acyloxy, or together with R₁ forms a carbonate;

10 R₄ is -OT₄ or acyloxy;

R₇ is acyloxy;

R₉ is hydrogen, keto, -OT₉, or acyloxy;

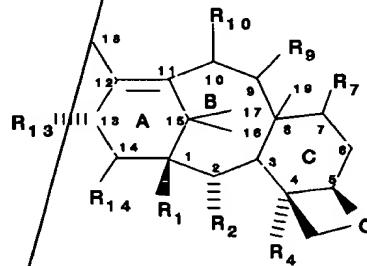
R₁₀ is hydrogen, keto, -OT₁₀, or acyloxy;

R₁₃ is hydroxy, protected hydroxy, keto, or MO-;

15 R₁₄ is hydrogen, -OT₁₄, acyloxy or together with R₁ forms a carbonate; and

T₂, T₄, T₉, T₁₀ and T₁₄ are independently hydrogen or hydroxy protecting group.

44. A taxane having the structure:



wherein

M is a metal or comprises ammonium:

R₁ is hydrogen, hydroxy, protected hydroxy, or together with R₁₄ or R₂ forms a carbonate;

R₂ is keto, -OT₂, acyloxy, or together with R₁ forms a carbonate;

R₄ is -OT₄ or acyloxy;

R₇ is -OT₇;

R₉ is hydrogen, keto, -OT₉, or acyloxy;

R₁₀ is hydrogen, keto, -OT₁₀, or acyloxy;

R₁₃ is hydroxy, protected hydroxy, keto, or MO-;

R₁₄ is hydrogen, -OT₁₄, acyloxy, or together with R₁ forms a carbonate;

T₇ is a ketal or an acetal radical;

T₂, T₄, T₉, T₁₀, and T₁₄ are independently hydrogen or hydroxy protecting group.

45. The taxane of claim 44 wherein

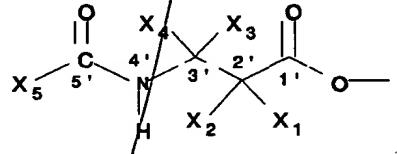
R₁ is hydroxy or together with R₁₄ or R₂ forms a carbonate;

5 R₂ is -OCOZ₂, -OCOOZ₂, or together with R₁ forms a carbonate;

R₄ is -OCOZ₄;

R₉ is hydrogen or keto;

R₁₃ is hydroxy, protected hydroxy, or



10 R₁₄ is hydrogen, hydroxy, protected hydroxy, or together with R₁ forms a carbonate;

X₁ is -OX₆ or -NX₈X₉;

X₂ is hydrogen, hydrocarbyl, or substituted hydrocarbyl;

15 X_3 and X_4 are independently hydrogen, hydrocarbyl, substituted hydrocarbyl, or heteroaryl;
 X_5 is $-X_{10}$, $-OX_{10}$, or $-NX_8X_{10}$;
 X_6 is a hydroxy protecting group;
 X_8 is hydrogen, hydrocarbyl, or substituted
20 hydrocarbyl;
 X_9 is an amino protecting group;
 X_{10} is hydrocarbyl, substituted hydrocarbyl, or heteroaryl; and
 Z_2 and Z_4 are independently hydrocarbyl, substituted
25 hydrocarbyl, or heteroaryl.

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